For this document, CALFED assumed that channel evaporation and conveyance consumption are not conservable and therefore need to be subtracted from the total existing loss values presented in Table 4-2.

To estimate how much of the existing loss is attributable to these factors, CALFED assumed:

Channel evaporation and conveyance consumption is equal to 2-4% of applied water.

This assumption is based on investigations made by Reclamation in the "Least-Cost CVP Yield Increase Plan" (DOI 1995) and supporting appendices. The Reclamation report was based on DWR data developed as part of DWR micro-scale water balances. (DWR uses Detailed Analysis Units [DAUs] for their smallest hydrologic scale; for example, there are 33 DAUs for the Sacramento River Region alone). In these water balances, DWR estimated water lost to evaporation and channel consumption. When compared to the conveyance loss values presented in the Reclamation report, the CALFED assumption is supported. The CALFED assumption multiplied by the applied water data in Table 4-1 results in a range of loss that encompasses the values stated by Reclamation). In the example table, this calculation is derived by multiplying the percentage lost to channel evaporation and consumption ("D") by the applied water input data ("A"). The results are presented in area "E."

This relationship provides the best available information since accurately determining the amount of water loss to channel evaporation and consumption is nearly impossible. For CALFED's purposes, using either the Reclamation actual data or the original DWR data did not appear to provide significant improvements in the accuracy of conservation estimates versus using the assumed percentages. Table 4-4 presents the resulting estimate of channel evaporation and conveyance consumption.

Table 4-4. Range of Channel Evaporation and Conveyance Consumption Values (TAF)

REGION	APPLIED WATER[1]	RANGE OF POSSIBLE LOSS FROM CHANNEL EVAPORATION AND BANK CONSUMPTION[2]
Sacramento River	6,278	125-250
Delta	1,116	22-44
Westside San Joaquin River	1,361	27-54
Eastside San Joaquin River	4,043	80-160
Tulare Lake	9,209	185-370 3
San Francisco Bay	97	2-4
Central Coast	48	1-2
South Coast	755	15-30
Colorado River	2,812	56-112
Total	**25,719**	**513-1,026**

[1] See Table 4-1.

[2] These values were calculated by multiplying the applied water value by 2% and 4%, respectively. They are defined as irrecoverable losses but are not conservable. Subtracting them from the total loss helps estimate remaining conservation potential. Subtracting them from the total irrecoverable loss helps estimate the conservation potential that is available for reallocation to other purposes.

[3] The Tulare Lake Region has such a high applied water value that the range of channel evaporation/ET is reduced to only 2-3%.

Calculating Remaining Conservable Water

Before moving on to the next set of assumptions used in estimating conservation potential, the irrecoverable, nonconservable values calculated above need to be subtracted from the existing and irrecoverable loss values calculated previously (see area "B" on the example table). Table 4-5 presents the remaining existing loss and irrecoverable loss eligible for conservation. These values are still subject to technical limits in on-farm irrigation and district delivery systems that will further decrease the final estimated conservation potential. This is discussed in more detail in the next subsection. On the example table, these results are shown in area "F."

Table 4-5. Remaining Conservable Losses (TAF)

REGION	EXISTING LOSS [1]	IRRECOVER-ABLE LOSS [2]	RANGE OF REMAINING EXISTING LOSS [2]	RANGE OF REMAINING IRRECOVER-ABLE LOSS [3]
Sacramento River	2,182	225	1,915-2,049	0-92
Delta	358	22	312-355	0
Westside San Joaquin River	388	68	310-344	0-24
Eastside San Joaquin River	1,262	104	1,093-1,177	0-19
Tulare Lake	2,315	602	1,676-1,951	57-238
San Francisco Bay	23	12	17-20	6-9
Central Coast	10	1	7-9	0
South Coast	213	123	126-157	36-67
Colorado River	635	565	252-385	182-315
Total	**7,386**	**1,722**	**5,708-6,447**	**281-764**

[1] See Table 4-2.

[2] Value is calculated by subtracting the leaching requirement (see Table 4-3) and the channel evaporation and consumption (see Table 4-4) from the existing loss. This value is available for conservation resulting from improved on-farm irrigation and district delivery practices.

[3] Value is calculated by subtracting the leaching requirement (see Table 4-3) and the channel evaporation and consumption (see Table 4-4) from the irrecoverable loss. As a subset of the existing loss, this value is available for conservation resulting from improved on-farm irrigation and district delivery practices.

Splitting Conservation Potential among No Action Alternative, CALFED, and Remaining Increments

The conservable water is defined as the remaining existing loss after the nonconservable portions are subtracted (see Table 4-5), with the exception of accounting for the technology limit previously noted. To conserve the entire potential, all farms and delivery systems would need to achieve 100% efficiency in their delivery to the growing plant. Realistically, this is not possible because of technical limits in manufacturing, managing, and maintaining on-farm and district delivery systems. However, saving a portion of this amount is possible.

CALFED has assumed that 40% of the potential can be conserved under the No Action Alternative and an additional 30% can be conserved as a result of CALFED alternative scenarios. Thus, CALFED assumes that 70% of the estimated conservation potential can be achieved. The remaining 30% is considered nonattainable due to technology and management limits.

To estimate the conservation savings for each increment (the No Action Alternative and CALFED solution alternative), the conservable water was split into three pieces based on the 40% and 30% assumed limits, respectively. On the example table, this is shown in area "G." The incremental savings corresponding to the No Action Alternative and CALFED alternative scenarios are identified.

The non-linear distribution assumes that the majority of the water saving potential can be achieved with initial efficiency improvements and that saving water becomes increasingly more difficult as 100% efficiency is approached.

When applied to the conservable water values shown in Table 4-5, these factors allow an estimate of how much of the total conservation potential can be saved as efficiency incrementally improves. Tables provided in Attachment A present the distribution for each region along with all of the other assumptions used to derive potential conservation savings. On the example table, this is shown in area "G."

4.7.3 Conservation Estimates: No Action Alternative vs. CALFED Solution and Farm-Level vs. District-Level Savings

As previously discussed, CALFED assumes that 70% of the conservation potential can be achieved as a result of the Water Use Efficiency Program. The No Action Alternative increment comprises the first 40% of this value.

Estimated conservation potential for the No Action Alternative increment and the CALFED increment were distinguished by taking the incremental savings (described in the previous subsection):

No Action Alternative increment	=	**First 40%**
CALFED increment	=	**Next 30%**
Remaining increment	=	**Final 30%**

Regional tables on the following pages present values for each of the nine CALFED regions. The values are displayed in three different tables to distinguish between different benefits of the savings (see area "H" on the example table):

- ***Recovered Losses with Potential for Rerouting Flows*** - These losses currently return to the water system, either as groundwater recharge, river accretion, or direct reuse. Reduction in these losses would not increase the overall volume of water but might result in other benefits, such as improving water quality, decreasing diversion impacts, improving flow between the point of diversion and the point of return, or potentially making water available for irrigation or in-stream flows during dry periods. (See Section 4.4, "Irrecoverable vs. Recoverable Losses.")
- ***Potential for Recovering Currently Irrecoverable Losses*** - These losses currently flow to a salt sink, degraded aquifer, or the atmosphere and are unavailable for reuse. Reduction in these losses would increase the volume of useable water (reducing these losses can make water available for reallocation to other beneficial uses). (See Section 4.4, "Irrecoverable vs. Recoverable Losses.")
- ***Potential Reduction of Application*** - This is the sum of the previous reductions.

In addition to distinguishing between the No Action Alternative increment and the CALFED increment, the estimated conservation savings were separated into on-farm and district improvements. This distinction is provided to illustrate the general relationship between the losses and who may be able to conserve them. To estimate this split, CALFED assumed that, on average, two-thirds of the projected savings were attributable to on-farm improvements. One-third, therefore, was available to conserve through district improvements. This amount is expected to vary by district, however.

To allow for anticipated variation, an adjustment factor was created to account for four typical district-level types of improvements: canal lining, district tailwater recovery systems, delivery flexibility, and measurement and volumetric pricing. Each district has a different philosophy regarding these factors and will focus more on one or another. Furthermore, some districts will stress all factors, while others may not consider any or only one or two. For example, for a district that practices conjunctive management of groundwater and surface water resources, lining irrigation canals can result in negative consequences. Thus, the district may not invest money in this type of conservation measure.

Each factor was given a default value of "1.0," so that all districts are assumed to start with a "4.0." If the districts that comprise a particular CALFED region were considered more or less likely to emphasize a particular factor, the values were adjusted up or down. This was accomplished by adjusting each of the conservation measure's value such that their sum would add to greater, equal to, or less than the assumed starting value of "4.0." For instance, if a region's factors added to five, the percentage of savings attributed to district-level activities was adjusted upward (greater than one-third of the conservation potential was attributed to district-level improvements). If the factors added to less than 4, the adjustment was downward. On the example table, this concept is illustrated at area "I."

The assumptions made for each region are presented in Attachment A (see the "I" area for each). These assumptions were based on professional judgment, considering some of the districts that comprise each region. The adjusted district-level conservation estimates ranged from a low of 17% for the Delta and Eastside San Joaquin River Regions to a high of 42% for the Colorado River Region (the San Francisco Bay and Central Coast Region estimates were only 8% because most of the water is "self-supplied" on farm via groundwater).

These estimates are illustrative and may not fully represent each unique on-farm/district relationship. The remainder of this section documents the results of applying this methodology to each CALFED agricultural region.

4.8 REGIONAL REDUCTION ESTIMATES

Estimates of the results of efficiency improvements are presented here for each of the agricultural regions defined previously in Section 3, "Determination of Geographic Zones." The values presented are to help understand the potential role conservation could play in the larger context of statewide water management, as well as to provide information for purposes of a programmatic-level impact analysis. **These are estimated goals, not required targets, and should not be used for planning purposes.**

Estimates of the potential savings for applied water, irrecoverable losses, and recovered losses are provided for each agricultural region in the tables that follow. This information is included in Tables 4-6a through 4-14c.

4.8.1 AG1 - SACRAMENTO RIVER

The Sacramento River Region is defined by the Sacramento Valley, from the city of Sacramento north to Redding. The area is predominantly in agriculture but many growing communities are within its boundary, including the greater metropolitan areas of Sacramento. All rivers that flow into the valley are carried by the Sacramento River southward to the Sacramento-San Joaquin Delta (Delta). Here, surface flows head west to the Pacific Ocean. With abundant surface water and groundwater resources, agriculture in this region experiences few water shortages. Water users in the Sacramento Valley possess some of the oldest rights to surface water, with some dating back to the Gold Rush Era. Agricultural water use comprises about 58% of the region's total water use.

Typically, losses associated with agricultural water use in this region tend to return to the system of rivers, streams, and aquifers. Reuse of these losses is widely practiced. The region does not have significant irrecoverable losses, although water quality degradation does occur. Much of the region's groundwater resources are recharged by annual over-irrigation and deep percolation of applied water as well as subsurface inflow from the surrounding mountain ranges. This water is pumped by many of the areas agricultural lands that are irrigated solely with groundwater. In addition, tailwater from fields typically returns to streams and becomes part of the in-stream flow diverted for another farm, wetland, or city somewhere downstream.

Agricultural production is anticipated to remain constant into the future, with no significant decreases resulting from the urbanization of areas around Sacramento. New land brought into production is expected to offset any loss of land to urbanization.

AGRICULTURAL INFORMATION
Sacramento River Region

Types of crops grown:	Rice, trees, tomatoes, corn, sugar beets, some truck crops, alfalfa and pasture.
Irrigated land:	Approximately 1,700,000 acres.
Types of irrigation systems in use:	About 70% of the area is under surface irrigation (furrow or border). Drip/micro systems are more prevalent on trees but constitute only a small portion (<10%).
Average applied water:	Approximately 6.3 MAF annually.
Source of water:	Groundwater, about one-quarter of the supply.
	Surface water from the Sacramento, Feather, and American Rivers and various tributaries. Surface water is diverted at multiple points, both by individuals and by water districts. Water is stored in numerous reservoirs and released based mostly on agricultural demands.
	Reuse of losses is an important feature in this area, with deep percolation and tailwater runoff being recovered and reused for other beneficial uses.

Sacramento River Region

Table 4-6a. Total Potential Reduction of Application (TAF)

USE	TOTAL EXISTING LOSS2	NO ACTION	INCREMENTAL CALFED SAVINGS1	TOTAL POTENTIAL[2]
On farm	--	511-546	383-410	894-956
District	--	255-273	191-204	446-477
Total	**2,182**	**766-819**	**574-614**	**1,340-1,433**

[1] See Table 4-2. Much of this loss is reused downstream for other beneficial uses, including in-stream flow.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-6b. Potential for Recovering Currently Irrecoverable Losses (TAF) (Subset of 4-6a)

USE	TOTAL EXISTING LOSS2	NO ACTION	INCREMENTAL CALFED SAVINGS1	TOTAL POTENTIAL[2]
On farm	-	0-24	0-18	0-42
District	-	0-12	0-9	0-21
Total	**225**	**0-36**	**0-27**	**0-63**

[1] See Table 4-2. The difference between these values and the total irrecoverable saving results from water leaching, water lost to channel evaporation and consumption, and limits on irrigation and water delivery technology.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-6c. Recovered Losses with Potential for Rerouting Flows (TAF) (Subset of 4-6a)

USE	EXISTING EXISTING LOSS	NO ACTION[1]	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[1]
On farm	-	511-522	383-392	894-914
District	-	255-261	191-195	446-456
Total	**1,957**	**766-783**	**574-587**	**1,340-1,370**

[1] See regional table in Attachment A at the end of this document for derivation of values.

4.8.2 AG2 - DELTA

The Delta Region is characterized by a maze of tributaries, sloughs, and islands that encompass 738,000 acres. Lying at the confluence of California's two largest rivers, the Sacramento and the San Joaquin, it is a haven for plants and wildlife. Islands, protected from Delta waters by an extensive levee system, are used primarily for irrigated agriculture. The vast majority of the 500,000 acres of irrigated land in the Delta derive their water supply directly by diverting water from the adjacent tributaries, rivers, and sloughs. Agricultural land use is anticipated to decline in the future as a result of other CALFED ecosystem restoration activities.

The Delta Region is bounded on the north by the metropolitan area of Sacramento and on the south by the city of Tracy. The west is bounded by Chipps Island near the true confluence of the Sacramento and San Joaquin Rivers. There is little urban land use in the Delta; however, a few small farming communities are located in the region.

Local Delta water use is protected by a number of measures, such as the Delta Protection Act, the Watershed Protection Law, and water rights. Most water users have the right to divert water for beneficial uses on their land under the riparian water rights doctrine. Water diverted and applied to fields, but not consumed, typically is collected in drains and pumped back into the Delta waterways. Because of this recycling of losses, there is no potential to generate actual water savings available for reallocation to other beneficial uses.

AGRICULTURAL INFORMATION
Delta Region

Types of crops grown:	Tomatoes, corn, sugar beets, some truck crops, alfalfa, and pasture.
Irrigated land:	Approximately 500,000 acres.
Types of irrigation systems in use:	Most of the area is under surface irrigation (furrow or border). Some use of hand-move sprinklers also occurs but primarily for pre-irrigation and germination.
Average applied water:	Approximately 1.1 MAF annually
Source of water:	Groundwater, very limited use. Surface water is pumped directly from the Delta waterways. Reuse of losses is an important feature in this area, with tailwater runoff being pumped off each island back into Delta waterways.

Table 4-7a. Total Potential Reduction of Application (TAF)

USE	TOTAL EXISTING LOSS2	NO ACTION	INCREMENTAL CALFED SAVINGS1	TOTAL POTENTIAL[2]
On farm	-	104-112	78-83	182-195
District	-	21-22	15-17	36-39
Total	**358**	**125-134**	**93-100**	**218-234**

[1] See Table 4-2. Much of this loss is reused downstream for other beneficial uses, including in-stream flow.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-7b. Potential for Recovering Currently Irrecoverable Losses (TAF) (Subset of 4-7a)

USE	EXISTING IRRECOVERED LOSS2	NO ACTION	INCREMENTAL CALFED SAVINGS1	TOTAL POTENTIAL[2]
On farm	-	0	0	0
District	-	0	0	0
Total	**22**	**0**	**0**	**0**

[1] See Table 4-2. The difference between these values and the total irrecoverable saving results from water leaching, water lost to channel evaporation and consumption, and limits on irrigation and water delivery technology.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-7c. Recovered Losses with Potential for Rerouting Flows (TAF) (Subset of 4-7a)

USE	EXISTING RECOVERED LOSS2	NO ACTION[1]	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[1]
On farm	--	104-112	78-83	182-195
District	-	21-22	15-17	36-39
Total	**336**	**125-134**	**93-100**	**218-234**

[1] See regional table in Attachment A at the end of this document for derivation of values.

4.8.3 AG3 - WESTSIDE SAN JOAQUIN RIVER

The Westside San Joaquin River Region is bounded by Tracy on the north, the farming town of Mendota on the south, and the San Joaquin River on the east. Agriculture is the predominant feature in this region, with only a handful of small farming communities. Other than the San Joaquin River running along the eastern border, no major rivers provide surface water to the region. Most of the region's agriculture is supported by water exported through the California Aqueduct and the Delta Mendota Canal. These two canals are predominant features that run south through this region. Agricultural acreage is not anticipated to decline much in this area, other than what may result from higher water costs, some urbanization, and limited land retirement.

Toward the southern end of this region, referred to as the Grassland Area, agricultural drainage has become an increasing problem. Combinations of salts, imported by the canals, and naturally occurring trace minerals, such as selenium, have generated concern with drainage from agricultural fields. Some of this drainage results in deep percolation to shallow groundwater. This in turn has degraded the shallow groundwater, limiting potential reuse. Several studies have been completed or are under way to find solutions to the drainage problems, including efforts by the CALFED Program. It is anticipated that these efforts will result in source control measures, increased directed reuse of drain water on salt-tolerant crops (agroforestry), and possibly some land fallowing or land retirement. The source control measures will include improvements in on-farm irrigation efficiency, as well as other measures.

AGRICULTURAL INFORMATION
Westside San Joaquin River Region

Types of crops grown:	Cotton, tomatoes, corn, sugar beets, some truck crops, trees, vines, grain, pasture, and alfalfa.
Irrigated land:	Approximately 430,000 acres.
Types of irrigation systems in use:	Most of the area is under surface irrigation (furrow or border). Hand-move sprinklers are being used in combination with surface systems. Micro/drip systems are increasing in use for some row crops, such as peppers and tomatoes, and on trees.
Average applied water:	Approximately 1.36 MAF annually.
Source of water:	Groundwater is used extensively in the northern part of the region but is limited in the southern portion because of water quality degradation. Surface water is delivered primarily via the California Aqueduct or Delta Mendota Canal. Some surface water is delivered in exchange for San Joaquin River water. Indirect reuse of surface losses occurs regularly. Deep percolation, if not lost to degraded groundwater, also is reused.

Table 4-8a. Total Potential Reduction of Application (TAF)

USE	TOTAL EXISTING LOSS2	NO ACTION	INCREMENTAL CALFED SAVINGS1	TOTAL POTENTIAL[2]
On farm	-	78-86	58-64	136-150
District	-	46-51	35-39	81-90
Total	**388**	**124-137**	**93-103**	**217-240**

[1] See Table 4-2. Much of this loss is reused downstream for other beneficial uses, including in-stream flow.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-8b. Potential for Recovering Currently Irrecoverable Losses (TAF) (Subset of 4-8a)

USE	TOTAL EXISTING LOSS2	NO ACTION	INCREMENTAL CALFED SAVINGS1	TOTAL POTENTIAL[2]
On farm	-	0-6	0-4	0-10
District	-	0-3	0-3	0-6
Total	**68**	**0-9**	**0-7**	**0-16**

[1] See Table 4-2. The difference between these values and the total irrecoverable saving results from water leaching, water lost to channel evaporation and consumption, and limits on irrigation and water delivery technology.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-8c. Recovered Losses with Potential for Rerouting Flows (TAF) (Subset of 4-8a)

USE	EXISTING RECOVERED LOSS	NO ACTION[1]	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[1]
On farm	-	78-80	58-60	136-140
District	-	46-48	35-36	81-84
Total	**320**	**124-128**	**93-96**	**217-224**

[1] See regional table in Attachment A at the end of this document for derivation of values.